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CUTTING UNIT INCORPORATING A HELICAL MECHANISM FOR VARYING A CUTTING LENGTH AND METHOD FOR OPERATING THE CUTTING UNIT

Background of the Invention:

Field of the Invention:

The invention relates, generally, to a cutting unit, and more specifically, to a printing system or folder incorporating the cutting unit.

Description of the Related Art:

In the art of printing systems, folders are used to cut signatures having varying lengths. In order to decrease the length of the signature, it is necessary to increase the angular velocity ratio between the folder and the printing units. As a result, the velocity of the signature is increased after it is cut. The increased velocity of the signature is counterproductive to downstream transport and deceleration functions. Therefore, the signature must be engaged by a deceleration mechanism for decelerating the signature before the signature can be further processed. Unfortunately, there is the inherent risk of damaging the signatures (i.e. dog-earing) and/or jamming the folder whenever the custody of the signature must be transferred from one machine component to another, i.e. from a transport unit

to a deceleration unit. Therefore, it is desirable to limit the number of signature transfers occurring throughout the printing process.

The prior art folders are also known to cut the signature with a raking action of a serrated knife. The serrated knife thereby producing a saw-tooth (ragged) cut. The ragged cut is not desirable in the final product and therefore a subsequent trimming process is usually required to put the product in final form with a smooth edge.

Summary of the Invention:

It is accordingly an object of the invention to provide a cutting unit incorporating a helical mechanism for varying a cutting length and a method for operating the cutting unit which overcome the herein-mentioned disadvantages of the heretofore-known devices and methods of this general type, in which a ribbon can be cut to different lengths without increasing the velocity of the cut signatures or changing hardware components.

With the foregoing and other objects in view there is provided, in accordance with the invention, a cutting unit containing a pair of cylinders disposed opposite one another with a gap formed there-between for receiving a ribbon. The pair of cylinders is formed of a first cutting cylinder having

a periphery with a cutting knife disposed helically about the periphery and a second cylinder. A drive rotates the first cutting cylinder for cutting the ribbon such that a signature cut from the ribbon has a smooth, straight edge.

In accordance with an added feature of the invention, the drive is a first drive and there is provided a second drive rotating and mounting the second cylinder. The first drive and the second drive rotate the cylinders such that a component of travel of a point of contact between the cylinders in a direction of travel of the ribbon matches a speed of the ribbon for cutting the ribbon in a straight line. The drives can be motors, gears to be driven by motors, and other generic types of drives.

In accordance with an additional feature of the invention, a control unit is connected to and controls the first drive and the second drive for controlling a rotational speed of the first cutting cylinder and the second cylinder.

In accordance with another feature of the invention, the cutting unit has a subframe with a pivot point about which the subframe is pivotable. The first drive, the second drive, and the cylinders are supported by the subframe. A further drive is connected to the subframe for pivoting the subframe about its pivot point. A position of the subframe controls a

position of the cylinders in regard to the ribbon and therefore controls a cutting length of the ribbon.

In accordance with a further feature of the invention, a sensor is connected to the control unit, the sensor provides control signals to the control unit for controlling the operation of the cylinders. The sensor is selected from the group consisting of cameras, optical scanners, speed sensors, and position sensors, and the control unit is a microprocessor based control unit.

With the foregoing and other objects in view there is also provided, in accordance with the invention, a folder formed of a frame, a subframe pivotally mounted in the frame about a pivot point, a drive housed in the subframe, and a pair of cylinders supported by the subframe and disposed opposite one another with a gap formed there-between for receiving a ribbon. The pair of cylinders includes a first cutting cylinder having a periphery with a cutting knife disposed helically about the periphery and a second cylinder. The first cutting cylinder is driven by the drive for cleanly cutting the ribbon such that a signature cut from the ribbon has a smooth, straight edge.

With the foregoing and other objects in view there is further provided, in accordance with the invention, a method for

cutting ribbons. The method includes the step of transporting a ribbon between a pair of cylinders of a cutting unit disposed pivotally in a folder. The pair of cylinders includes a first cutting cylinder having a periphery with a cutting knife disposed helically about the periphery and a second cylinder. The cylinders are rotated such that a component of travel of a point of contact between the cylinders in a direction of travel of the ribbon matches a speed of the ribbon for cutting the ribbon such that a signature cut from the ribbon has a smooth, straight edge.

In accordance with a concomitant feature of the invention, there are the steps of increasing an angle between the cylinders and the ribbon for decreasing a cutting length of the signature, and adjusting a rotational speed of the cylinders for maintaining a straight cut of the signature; and decreasing the angle between the cylinders and the ribbon for increasing the cutting length of the signature, and adjusting the rotational speed of the cylinders for maintaining the straight cut of the signature.

Other characteristic features of the invention are set forth in the appended claims.

Although the invention is illustrated and described herein as embodied in a cutting unit incorporating a helical mechanism

for varying a cutting length and a method for operating the cutting unit, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

The construction of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

Brief Description of the Drawings:

Fig. 1 is a diagrammatic, plan view of a cutting unit according to the invention;

Fig. 2 is a plan view of the cutting unit; and

Fig. 3 is a side-elevational view of a subframe pivotably mounted in a frame of a folder.

Description of the Preferred Embodiments:

In all the figures of the drawing, sub-features and integral parts that correspond to one another bear the same reference symbol in each case. Referring now to the figures of the

drawings in detail and first, particularly, to Fig. 1 thereof, there is shown a cutting unit for cutting a ribbon 1 such as a ribbon of paper. The cutting unit includes a pair of cylinders including a first cutting cylinder 2 disposed above the ribbon 1 and a second cylinder 3 disposed below the ribbon 1. The first cutting cylinder 2 has on its periphery a helically configured cutting knife 4. The second cylinder 3 may be a blank cylinder, have a mating anvil or be formed of "cutting rubber". A gap is formed between the cylinders 2, 3 which gap receives the ribbon 1.

The cylinders 2, 3 are oriented at an angle α to the ribbon 1, and the cylinders 2, 3 are driven or rotated by drives 5, 5' at a speed proportional to a speed of the ribbon 1. As the cylinders rotate 2, 3, a point of contact (i.e. a point of cutting) between the cylinders 2, 3 travels across a width of the ribbon 1 and also in a direction of travel 7 of the ribbon 1 due to helical configuration of the cutting knife 4. In order to cut the ribbon 1 in a straight line, the proportionality constant of rotation of the cylinders 2, 3 is chosen such the component of travel of the point of contact in the direction of travel 7 of the ribbon 1 exactly matches the speed of the ribbon 1. The drives 5, 5' are in turn controlled by a control unit 6 that may be part of the cutting unit, a folder that incorporates the cutting unit or the printing system that incorporates the cutting unit. The

drives 5, 5' may be motors, gears driven by a motor, a belt and pulley system, etc.. The control unit 6 is a microprocessor based control system.

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When a different cut-to-length of the ribbon 1 is required by the printing system, the angular orientation α of the cylinders 2, 3 relative to the ribbon 1 is changed. In addition, the proportionality constant of rotation of the cylinders 2, 3 is adjusted so that the component of travel of the point of contact in the direction of travel 7 of the ribbon 1 still matches the speed of the ribbon 1.

If the angle α of the cylinders 2, 3 in relationship to the ribbon 1 is decreased (the cylinders 2, 3 are oriented more parallel to the ribbon 1), the cylinders 2, 3 are rotated faster for a given press speed to maintain a straight cut. Reorienting the cylinders 2, 3 in this direction results in a longer cut-to-cut length of the ribbon 1. On the other hand, if the angle α of the cylinders 2, 3 in relationship to the ribbon 1 is increased (the cylinders 2, 3 are oriented less parallel to the ribbon 1), the cylinders 2, 3 are rotated slower for a given press speed to maintain a straight cut. Reorienting the cylinders 2, 3 in this direction results in a shorter cut-to-cut length of the ribbon 1.

In Fig. 2, the cylinders 2, 3 are oriented more parallel to the ribbon 1. Therefore the cut-to-cut length of the ribbon 1 is changed by an amount δ.

Fig. 3 shows a side view of a subframe 9 of the cutting unit that is in turn housed in a frame 10 of a folder. The subframe 9 and the frame 10 are only diagrammatically shown in the drawing. The subframe 9 houses the drives 5, 5' which in turn mount and rotate the cylinders 2, 3. In Fig. 3 the drives 5, 5' and the cylinders 2, 3 are not visible as they reside on the other side of the subframe 9. The subframe 9 is pivotable with regards to the frame 10 and therefore, the cylinders 2, 3 can be pivoted in regards to the ribbon 1 and the angle α can be controlled by the location of the subframe 9 to the frame 10. The subframe 9 has a pivot point 11 about which it can be driven by a drive or cylinder 12 such as an air cylinder or a hydraulic cylinder. In addition, the subframe 9 can be pivotably mounted with the frame 10 in a ball and screw fashion. It is noted that many manners of mounting the subframe 9 to frame 10 are known and any pivotable manner is acceptable and the two forms discussed are only examples of many possibilities.

Sensors 8 are disposed in the travel path of the ribbon 1 and are connected to the control unit 6 for monitoring the cutting

operation of the ribbon 1 (only one of the sensors is shown to be connected to the control unit for clarity reasons). The sensors 8 provide data to the control unit 6 for adjusting the cutting operation of the ribbon 1. Should the sensors 8 detect an unacceptable cut, the control unit 6 can adjust the rotational speed of the cylinders 2, 3 via the drives 5, 5' or adjust the angle α. In addition, the sensors 8 can detect a faulty operation of the cutting unit and instruct the shutdown of the cutting unit. The sensors 8 can be cameras, scanners, speed sensors, optical scanners, etc..

The nature of the cutting process represents two of the virtues of the invention. First, and unlike most folders that cut all at once between the rotating cylinders, the cutting process can be spread over as much time as desired. This greatly reduces the impulse forces that are created and transmitted back through the cutting unit and the printing system. The impulse forces having a disruptive effect on other printing processes including the registration of the cut to the print on the ribbon 1. Second, the protracted cutting can be done using blades that produce a clean, unserrated cut. Therefore, no further additional finishing steps are necessary (i.e. cutting away the serrated cut in the prior art). This results in savings in that no additional cutting equipment is necessary, paper waste is reduced, and the printing process is quicker.